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Title: Implementation Plan APU-Ether Bag out Bags

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Implementation Plan APU-Ether Bag out Bags



ORI-2
Container Management Team
5-6-20



Managed by Triad National Security, LLC for the U.S. Department of Energy's NNSA

Outline



- What is APU-Ether
- What is the need
- Previous Research
- General Cost
- Bag Manufacturability
- Pilot Program
- Facility Wide Implementation
- Summary

What is APU-Ether ?

- APU-Ether is known as Aromatic Polyurethane Ether
- It is a material that has been selected for the manufacturing of bag out bags for use in PF-4.
- The current sPVC or suspended polyvinyl chloride and PVC bag generate HCl gas as they degrade over time.
- This gas is a corrosive product and over time with help of temperature and radioactive exposure it will corrode the container that it's in.
- APU-Ether does not generate HCL gas when it degrades, so by using it we can help mitigate some of the corrosion that is occurring inside the container.
- APU-Ether used commonly in industry for the manufacture of foams, food containers, and gaskets.

What is the Need ?

- Since it is now known that APU-Ether does not generate the corrosive gas products it makes it an ideal candidate for a new bag out bag.
- Multiple programmatic organizations would benefit from having a higher performance bag out bag.
- Less potential for contamination inside the nuclear material storage containers. Would lead to the faster turn around times for many operations in the plant.
- In general a bag out bag that displays higher performance results is a safer interface with plant workers.
- The need is to get this new bag phased into the facility in the safest most efficient way possible.

Previous Research



The following research sides are a summary of 2 reports generated by a collaborating team from Chemistry Division and members of the container management team.

The stability of sPVC bags commonly used for storage of nuclear materials was tested by exposing the material to alpha and gamma radiations as well as thermal treatments. Furthermore, commercially available plastic bags made from aromatic polyether urethane and aromatic polyester urethane were also tested under similar harsh conditions as well as a long-term aging study.

Previous Research (Continued)

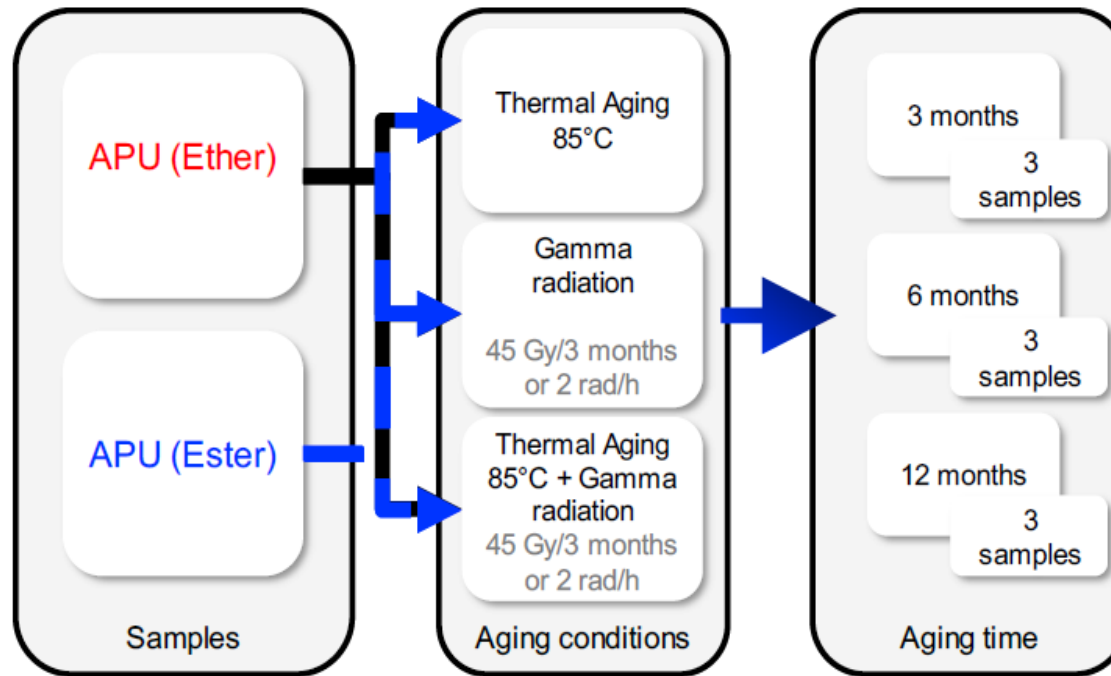


Figure 2. Scheme of the aging study conducted in the present work.

This is the frame work that was used for the thermal aging study in this case we are only concerned with APU-Ether, however the tests were conducted with other potential candidates for comparative performance analysis as shown above.

Previous Research (Continued) Tension & Puncture Tests

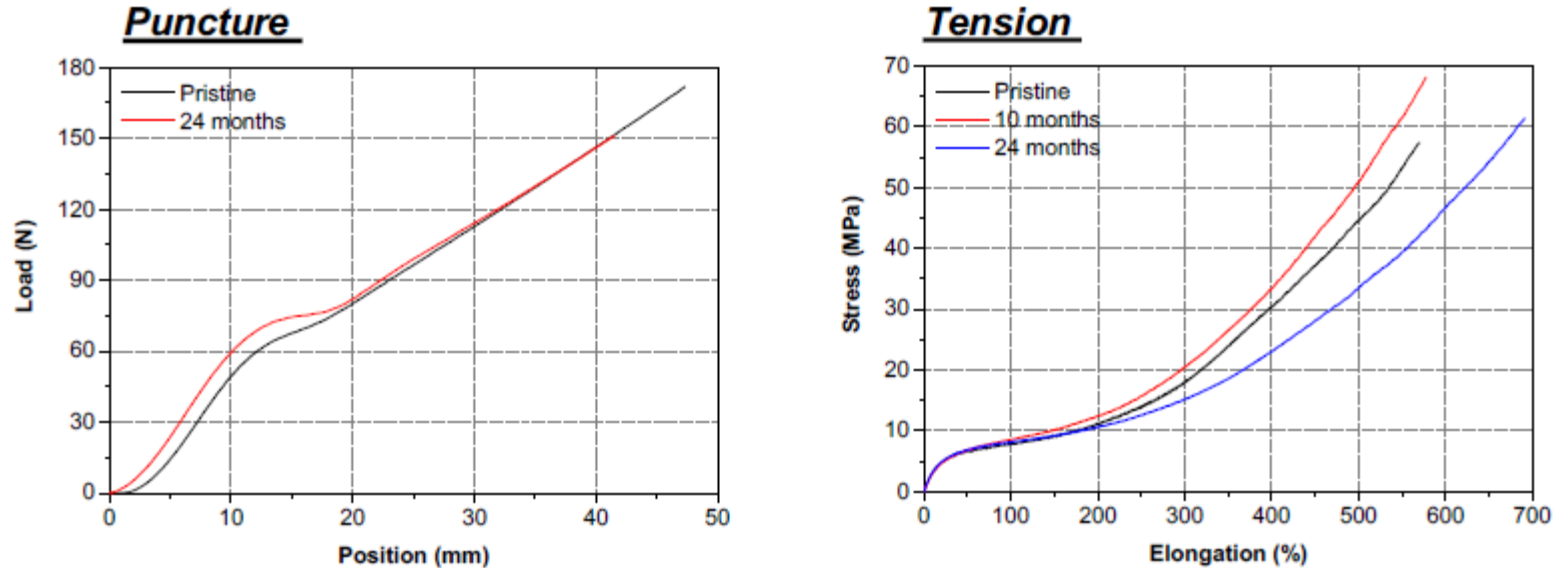
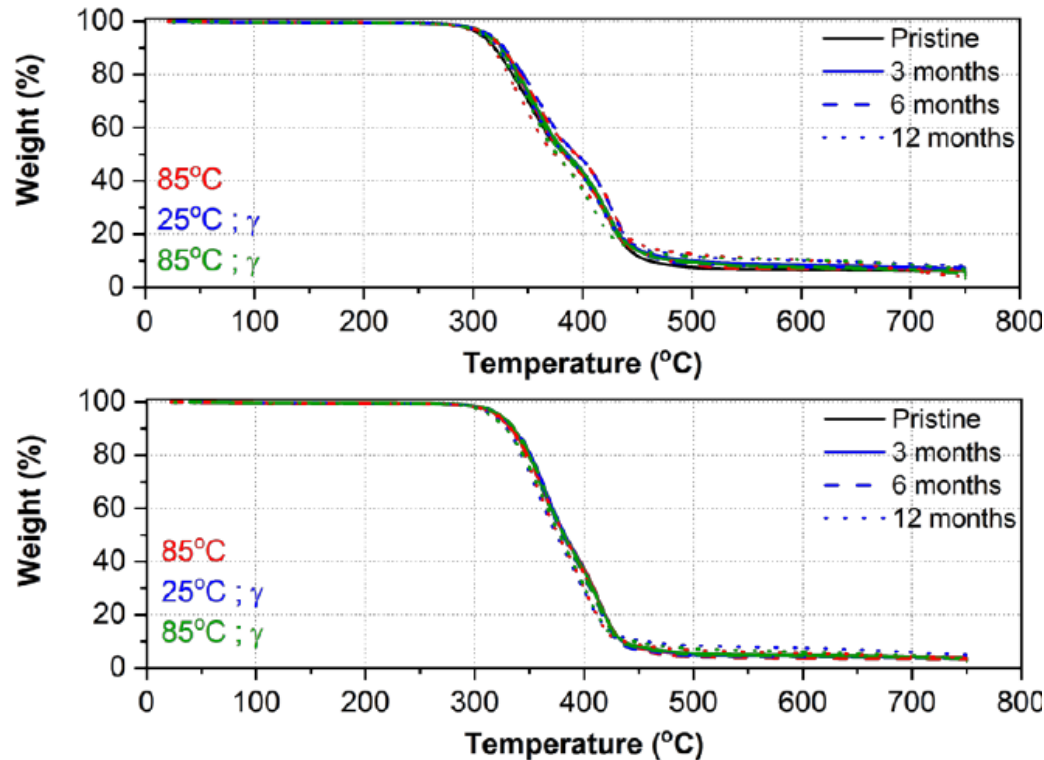


Figure 15. Puncture and tensile data obtained for samples aged for up to 12 months at TA-55.

APU(ether) shows a slight decrease in the load needed to puncture the material after 24 months of aging. Similarly to the accelerated aging data, there is a slight change in tensile strength and elongation at break compared to control samples. Overall, APU(ether) samples that were aged in storage environments for 24 months show similar behavior as samples aged under more controlled lab conditions.

Previous Research (Continued) Thermal Stability



The TGA experiments indicate that the thermal stability of accelerated aged samples is not influenced by the thermal treatment and/or by the gamma radiation exposure since thermal decomposition follows the behavior of pristine samples.

Figure 8. TGA data for pristine and aged APU-ether (top) and APU-ester (bottom).

Previous Research (Continued) Chemical Stability

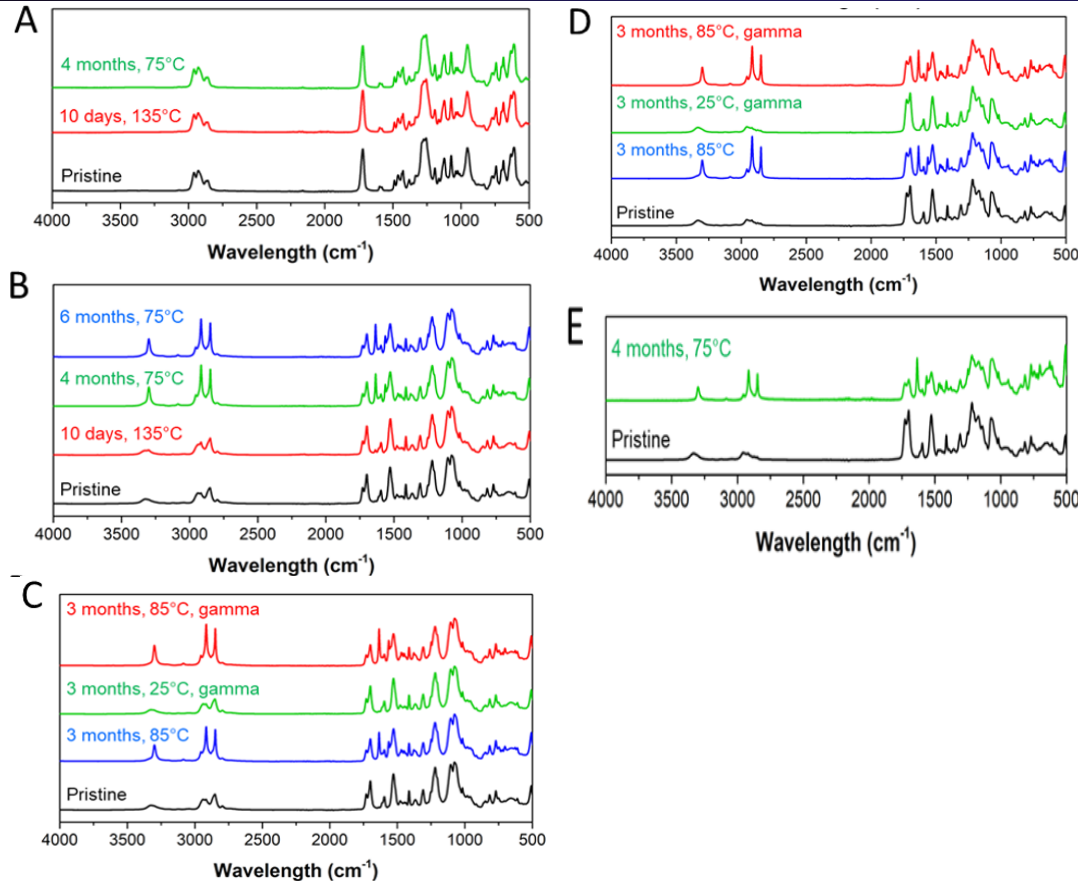


Figure 3-14 FT-IR spectra of pristine, thermally aged and irradiated sPVC (A), APU ether bags (B, C) and APU ester bags (D, E)

Different thermally aged conditions have been used to evaluate the thermal resistance of the sPVC, APU-ether, and APU-ester bags.

The sharp peaks at 3316, 2916, 2846, 1639, and 1568 cm⁻¹ are caused by the ethanol cleaning solvent for the FT-IR equipment. [12] APU-ether (Figure 3-14 B,C) and APU-ester (Figure 3-14 D,E) bags under thermal and irradiated conditions were investigated to evaluate the combined effect.

Previous Research (Continued) Chemical Stability

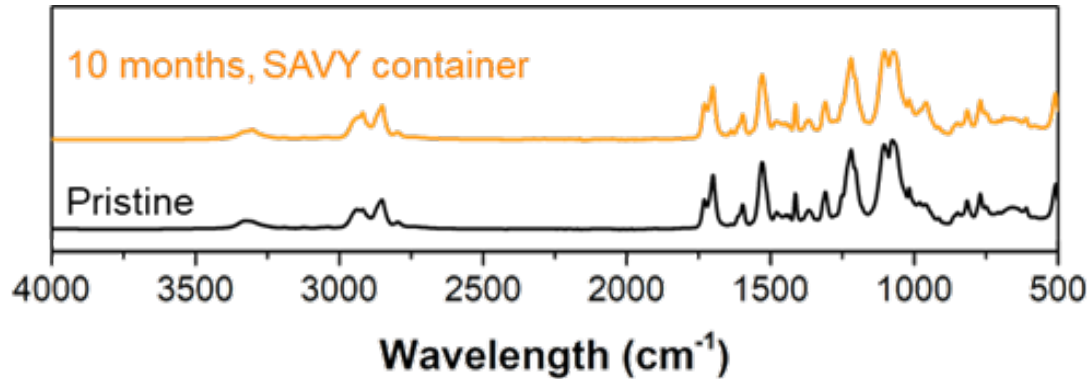


Figure 3-15: FT-IR spectra of APU-ether bags under real operation condition

The chemical fingerprint of the sPVC, aromatic polyether urethane (APU-ether) and aromatic polyester urethane (APU-ester) bags was tested using Fourier transform infrared (FT-IR) spectroscopy. This technique is used to identify chemical bonds in a material by producing an infrared absorption spectrum.

FT-IR of APU-ether bag has been observed after 10 months operation under real conditions and compared with the pristine sample. As shown in Figure 3-15, no significant change has occurred, exhibiting a superior resistance to thermal and irradiated aging, even under real operation conditions.

Previous Research (Continued) Solvent Swelling

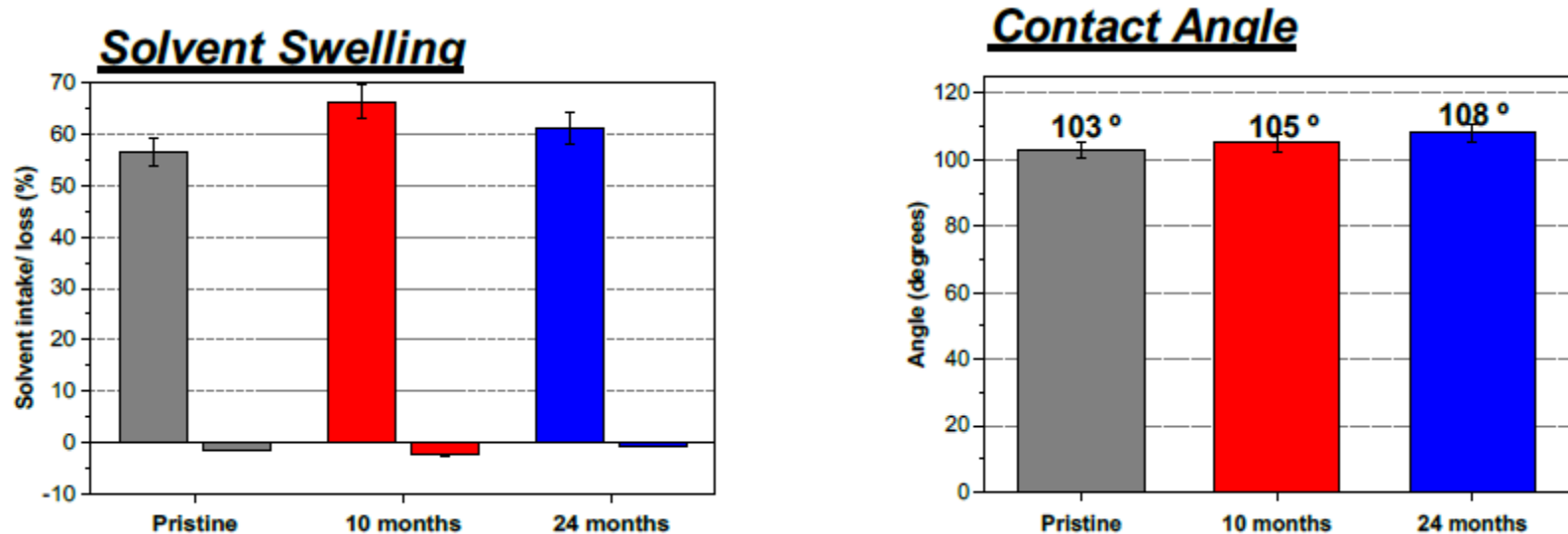


Figure 13. Solvent swelling and contact angle data obtained for samples aged for up to 12 months at TA-55.

Solvent swelling and static contact angle experiments were performed on TA-55 samples with results shown in Figure 13. There is a slight increase in hydrophobicity with aging since the contact angle changes from 103° to 108°, which is similar to results obtained for accelerated aged APU(ether)samples. Solvent swelling data is also shown in Figure 13 and there is no noticeable trend with aging, similar to accelerated aging results.

Previous Research (Continued) In-Glovebox Sample



Figure 3-18 Low dose APU ether sample after 8 months of exposure

The low dose samples were placed in close proximity of the 3013 full-scale experiments within the insulation portion of the experiment [14]. The study exposed the APU ether and sPVC samples to both heat and a radiolytic environment. After approximately 8 months the samples were checked for the degradation criteria listed in the methodology section.

Previous Research (Continued) Cold Bag-Out Trial



Figure 3-20 A bag change being performed on the APU ester

The first bag material to be used was the sPVC, which is what is currently being used in PF-4. The comments from the operators was that they did not notice any differences in the way this bag behaved on the cold glovebox. This result was expected but needed to be verified before gathering the information on the alternative bag materials.

Next, the APU ether was used and a bag change (Figure 3 20) was performed over the sPVC. Once the APU ether bag was on the bag-out bag port a dummy item was placed into the new bag and a stub was created and cut off of the glovebox.

Previous Research (Continued) Cold Bag-Out Trial

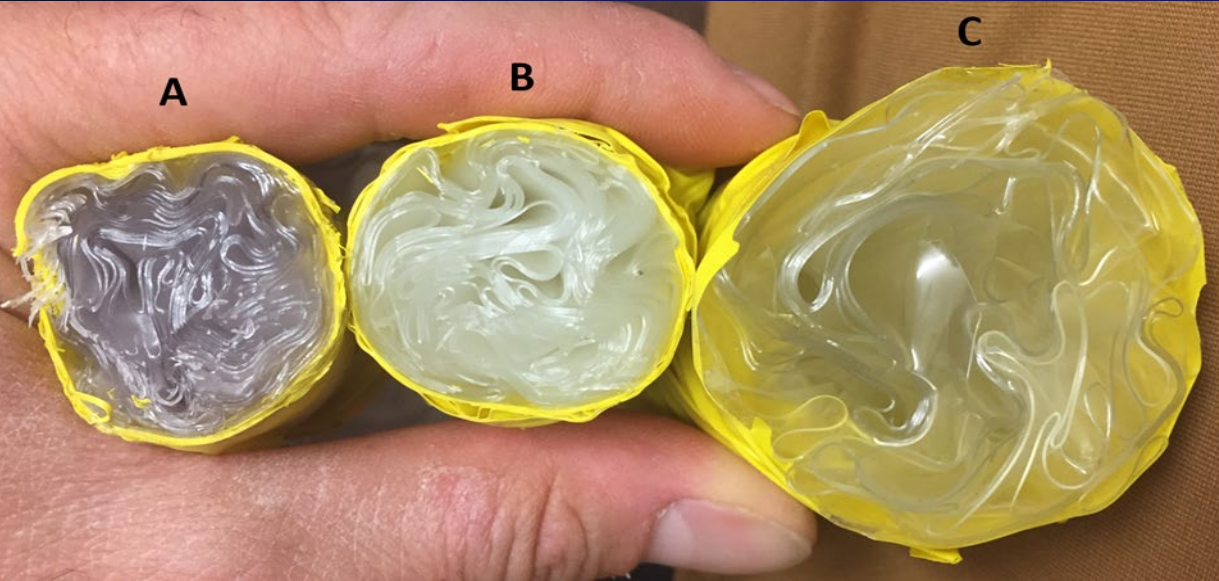


Figure 3-21A comparison of stubs from each bag-out bag material. (from left: sPVC, APU ether, APU ester)

It should be noted that the density of stub is similar between the sPVC (Figure 3-21, A) and the APU ether (Figure 3-21, B) and would be expected to perform similarly with regards to maintaining a seal. The fact that that APU ether had a tighter stub than APU ester was assumed to be due to the fact that the APU ester bag material was not able to slide on itself as easily compared to the APU ether.

Cost Comparison PVC vs. APU-Ether

- Have received RFQ's from NFT Inc. for a single bag size.

Model	Part Number	Material	Quantity	Price (each)	Price (Extended)
Bag-7	38012207	APU-E	50-100	\$ 148.06	\$ 7,402.80

This first quote was sent to LANL without the textured surface in mind.

Qty	Price Ea.
50	\$ 320.00
100	\$ 195.00

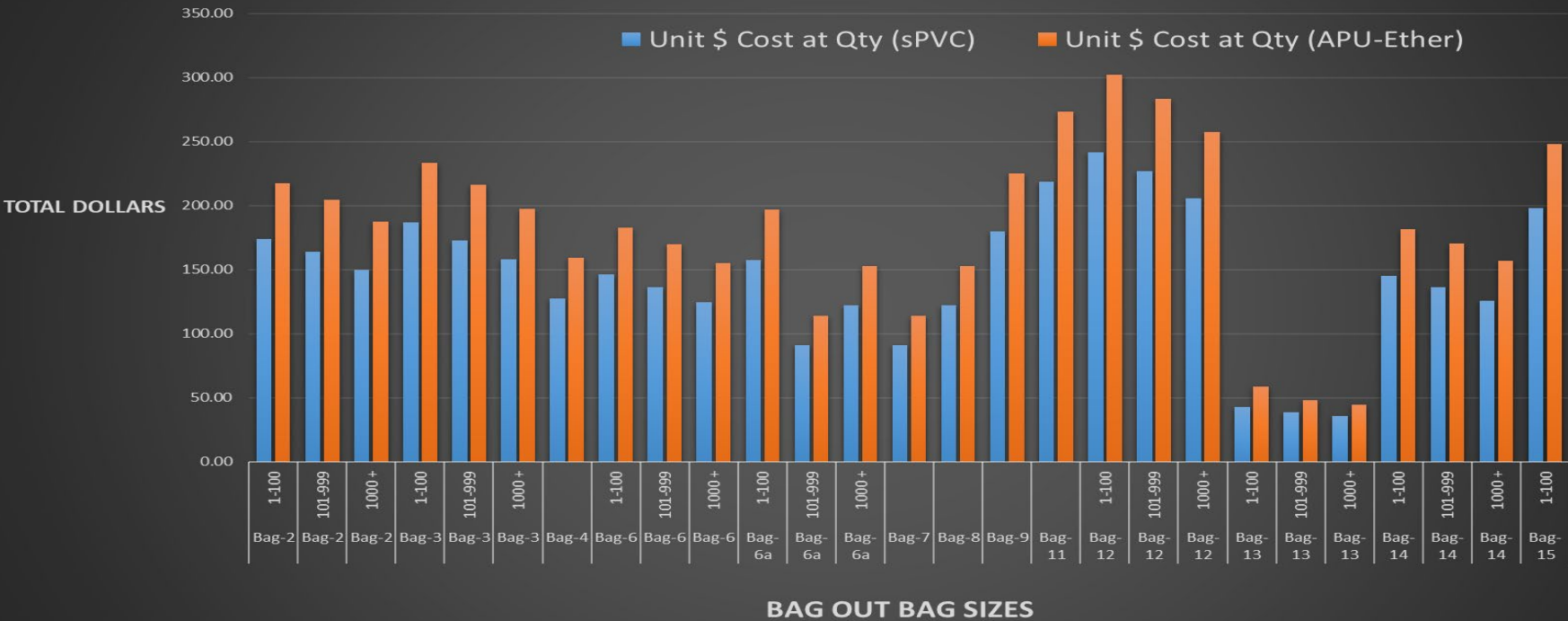
Second quote was released to LANL after the textured surface processing would be applied. Note this is for the Bag-7 size only.

PR is now in process by NPI-8 for the Bag-7 size expected lead time is 12-16 weeks.

Cost Comparison sPVC vs. APU-Ether (Continued)

Cost Comparison sPVC vs. APU-Ether Calendar Year 2020

Average Price Increase of 25%



General Cost (Continued)

- The Average Cost per bag out bag will be greater than the average cost of sPVC and PVC bags.(~25% Greater)
- Larger production orders will lower unit cost over time.
- The Material Supplier know as Rich Industries that NFT Inc. contracts with must generate a very large spool of material per bath.
- A large supply of material would be available for further orders in the future which could reduce lead times.
- This would prove beneficial to the facility upon entering full scale production of all bag out bag sizes.

Bag Manufacturability

- Lead times as is stands right now are 12-16 weeks after receipt of order for the production of only one bag size.
- The core material availability is plentiful, however the chemical batching and rolling processes take a considerable amount of time and expense to generate.
- The general aspects of the new APU-E bags will be the same as the older sPVC bags.
- The Filters, elastic band, and labeling attributes will remain the same. Only updated to describe the new material form as appropriate.
- This will allow NFT Inc. to not have to re-tool or change the current manufacturing process for the bag.
- NFT Inc. has already been making these types of bag for years and has a strong procedural process which reduces risk of potential defects.

Pilot Program

- An Implementation Plan has already been drafted and is with Document Control for formal review.
- This will be a 2 year program in which the container management team coordinates efforts with line organizations in the plant to bag out items using the new APU-Ether bag.
- These efforts will be preformed in conjunction with some container surveillance activities, however is not bound to only surveillance items.
- The items that will be proposed to be bagged out with the new APU-Ether bag will be of high wattage, high gram amount, MSE salts, in general the worst corrosive cases seen in the plant.
- The bags will be reinvestigated in 1 year and then again the next year, if no signs of degradation are present full implementation will begin.

Facility Wide Implementation

- After the Pilot Program has been completed and the results tabulated presented, if the program is success all bag out bag sizes will be allowed for use in the facility. If there is and issue that arises during the inspections of the new bag may be put on hold.
- As it stands now the TRU waste Acceptable Knowledge Specialists and the CCP have already accepted this material to be generated by TA-55 as a waste.
- The TA-55 warehouse has updated their PR for NFT Inc.'s. review for the increase in the Bag-7 order cost due to the 12 mil-textured transparent surface per TA55-SPEC-01000, R1.4.
- Looking into the future work with our collaborative team in Chemistry Division at TA-46, a batch inspection process has been proposed to monitor the quality of these new bag as we introduce them to TA-55.

Summary



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- Pilot Program
- Facility Wide Implementation